

SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

August 1990
NSRP 0320

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

1990 Ship Production Symposium

Paper No. 4B-2: Hazardous Waste Minimization Program at Philadelphia Naval Shipyard

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE AUG 1990		2. REPORT TYPE N/A		3. DATES COVERED -	
4. TITLE AND SUBTITLE The National Shipbuilding Research Program, 1990 Ship Production Symposium, Paper No. 4B-2: Hazardous Waste Minimization Program at Philadelphia Naval Shipyard				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Surface Warfare Center CD Code 2230-Design Integration Tools Bldg 192, Room 128 9500 MacArthur Blvd, Bethesda, MD 20817-5700				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release, distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT SAR	18. NUMBER OF PAGES 8	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

DISCLAIMER

These reports were prepared as an account of government-sponsored work. Neither the United States, nor the United States Navy, nor any person acting on behalf of the United States Navy (A) makes any warranty or representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this report/manual, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or (B) assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in the report. As used in the above, "Persons acting on behalf of the United States Navy" includes any employee, contractor, or subcontractor to the contractor of the United States Navy to the extent that such employee, contractor, or subcontractor to the contractor prepares, handles, or distributes, or provides access to any information pursuant to his employment or contract or subcontract to the contractor with the United States Navy. ANY POSSIBLE IMPLIED WARRANTIES OF MERCHANTABILITY AND/OR FITNESS FOR PURPOSE ARE SPECIFICALLY DISCLAIMED.

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM'S 1990 SHIP PRODUCTION SYMPOSIUM

**Preparing for the 21st Century:
Focusing on Productivity and Quality Management**



**August 22-24, 1990
Pfister Hotel
Milwaukee, Wisconsin**

**SPONSORED BY THE SHIP PRODUCTION COMMITTEE
AND HOSTED BY THE GREAT LAKES AND RIVERS SECTION OF
THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS**





THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
601 Pavonia Avenue, Jersey City, NJ 07306

Paper presented at the NSRP 1990 Ship Production Symposium,
Pfister Hotel, Milwaukee, Wisconsin, August 21-24, 1990

Hazardous Waste Minimization Program At Philadelphia Naval Shipyard

4B-2

James G. Kardas, Visitor, Arvind M. Nadkarni, Visitor, and Carl M. Olson, Visitor, Philadelphia Naval Shipyard, Philadelphia, PA

ABSTRACT

The Chief of Naval Operations (CNO) set forth the goal to reduce hazardous waste generation by 50% by 1992. This has provided Naval installations such as Philadelphia Naval Shipyard (PNSY) with an increasingly defined role as active participants in the nationwide effort to reduce or eliminate the generation of hazardous waste. PNSY Industrial Engineering Division has developed a comprehensive plan targeted at managing and reducing hazardous waste generation in the shipyard.

The first goal of the plan was to analyze and identify all the potential hazardous waste streams generated within the shipyard. A directory of all the shipyard waste streams was compiled indicating the type of wastes generated and the processes from which they originated. Upon completion of this identification, a Pareto Analysis was performed to rank the waste streams in consideration of quantity generated, cost of disposal and toxicity. The high ranking waste streams were targeted for immediate remedial action. This ensured success in meeting and exceeding the CNO goal and achieving maximum payback on engineering manhours dedicated to the program. These waste streams and the industrial processes which generated them were carefully analyzed. The feasibility of eliminating/recycling them through a process change or on-site treatment to effectively reduce their volume was studied. The Industrial Engineering Division has since initiated a variety of projects including treatment/recycling/elimination of hazardous waste in addition to critical process changes which reduce volume generation.

Success of this program is continuously pursued as part of Total

Quality Management and will allow Philadelphia Naval Shipyard to achieve the CNO goal, ensure compliance to federal, state and local regulations and produce a cost savings/avoidance for the shipyard in excess of 1 million dollars within the first two years of implementation.

BACKGROUND

The Philadelphia Naval Shipyard (PNSY) along with many private and public sector organizations utilizing hazardous materials have become increasingly aware of the importance of hazardous waste minimization. This is mainly due to three factors, total adverse impact of hazardous waste to the environment, rapidly increasing hazardous waste disposal costs, and growing legal and financial liabilities for noncompliance to regulations such as the Resource Conservation and Recovery Act (RCRA).

Due to the nature and extent of their operations, large Naval installations such as PNSY, have the capability of generating considerable amounts of hazardous waste within a short period of time. Along with this capability comes the responsibility and liability for legal, effective and economical management of this waste. OPNAVNOTE 5090 of May 1988 issued by the Chief of Naval Operations (CNO) set forth the goal to reduce hazardous waste generation by 50% through the five calendar year period 1988 to 1992 (base year being 1987). This policy statement emphasized the Navy's commitment to hazardous waste reduction and provided all Naval installations with a clearly defined goal and a measure on which to base the success of their minimization efforts.

Philadelphia Naval Shipyard under

guidance from Naval Sea Systems Command (NAVSEA), initiated a full scale, comprehensive program to manage hazardous material and minimize generation of hazardous waste. This program addresses management controls, hazardous material controls, waste minimization initiatives and proper handling and disposal of hazardous waste. As part of this program, the Industrial Engineering Division has been specifically assigned to analyze production processes in an effort to minimize hazardous waste. Two main objectives have since been set by PNSY Industrial Engineering. Primarily, achieve the CNO goal of 50% reduction in hazardous waste and secondarily, achieve a hazardous waste disposal cost savings of at least \$1,000,000 within the first two years of implementation.

MINIMIZATION STRATEGY

To effectively implement a hazardous waste minimization program, a comprehensive plan must first be developed. With long term minimization methods such as management controls for hazardous material acquisition, handling and disposal already implemented, Industrial Engineering focused directly on production processes generating hazardous waste. A waste stream directory was compiled to identify all processes generating waste, the type of waste generated, characteristics of the waste and the EPA identification number.

Considering the numerous sources of hazardous waste and the limited time frame available to achieve 50% minimization, Industrial Engineering compiled a "Top Ten" hazardous wastes list. The main criteria for choosing candidates for this list was highest volume generated and toxicity. This list was then arranged in a Pareto format, figure (1), to indicate a hierarchy of the top shipyard hazardous waste streams.

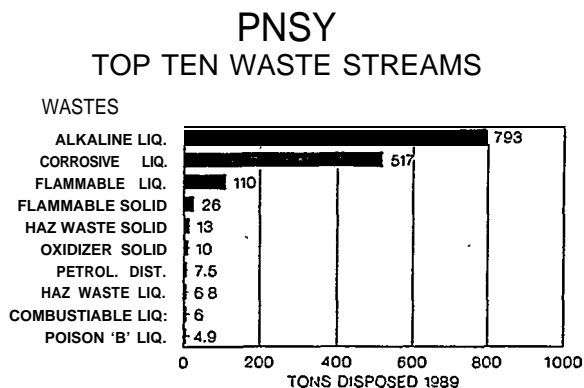


figure 1.

Analysis indicated that an 80% reduction of the first three waste streams, specifically alkaline liquid, corrosive liquid and flammable liquid, would result in achievement of both initial objectives. All major processes contributing to these waste streams were subsequently identified. These included electrical motor cleaning, metal pipe processing and a variety of cleaning and painting operations utilizing solvents.

Having the problem sufficiently defined and narrowed, the next step in the plan was to identify the most effective methods of minimization. Several industry proven alternatives were considered. Given the desired cost savings objective, contractor treatment or disposal was not considered. Additionally, considering time limitations, process changes requiring extensive testing and approval were given a lower priority. The remaining potential minimization techniques were reduced to four major categories:

1. Elimination

Eliminating and/or substituting hazardous chemicals in a process greatly reduces the toxicity of a waste stream generated by that process. Processes contributing to the three top waste streams were examined to determine if a less hazardous chemical or a process change could be used to reduce or eliminate the toxicity of the waste stream without affecting the quality of the end product.

2. Reutilization

During a production process a hazardous waste stream may often be generated that need not be referred to as "waste". Partially contaminated chemicals such as cleaning solutions or solvents may be used in a less stringent application or in the original application if they can be decontaminated in a cost effective manner (such as filtering).

3. Reclamation/Recovery

Solvents such as mineral spirits and Freon possess unique properties which allow them to be effectively distilled out of a waste stream to very high purity levels. Additionally, recent technology has provided the capability to capture and liquefy working gaseous refrigerants (CFC's). This process will provide an alternative to venting the gases into the atmosphere upon overhaul of equipment containing them.

4. Minimization by Volume Reduction

Minimization by volume reduction can provide significant hazardous waste minimization with an outstanding payback and return on investment. This, however, is often achieved with high initial investment costs (over \$20,000) and the need to acquire local permits. Volume reduction often involves treatment to render a dilute waste stream non hazardous. This treatment will usually concentrate hazardous constituents to a volume of 103 or less of the original waste stream.

External Technology Sources

To support the overall hazardous waste minimization effort, the Navy has dedicated certain functions of activities such as Naval Civil Engineering Laboratory (NCEL) and Naval Energy Environmental Support Activity (NEESA) to the development and implementation of hazardous waste minimization technologies.

There are several economic and applications advantages that this technical support provides to U.S. Naval installations. The majority of the research and development-required for these minimization projects is completed by NCEL or NEESA, thus saving local engineering costs. Additionally, these projects are specifically engineered for U.S. Navy related industrial operations. These minimization technologies include Hard Chrome Plating Retrofit, Boiler Hydroblast Solution Recycling and Recycleable Plastic Blast Media.

Implementation of minimization projects developed by activities such as NCEL and NEESA was given a high priority by the Industrial Engineering Division.

MINIMIZATION PROJECTS

Since the implementation of the Hazardous Waste Minimization Program, numerous projects have been initiated utilizing the guidelines outlined above. The following implemented or nearly implemented projects are presented.

Electrical Motor Component Cleaning

This operation generates approximately 30% of the total Shipyard hazardous waste. Alkaline cleaning solution is used to degrease motor and electrical components under overhaul.

The cleaning solution is either used in a dip tank or sprayed on via high steam pressure. Chemical analysis of the spent cleaning solution has indicated high pH and heavy metal content. The waste was normally disposed of through a contractor.

Analysis indicated that a high suspended solids content precluded cost effective recycling of the cleaning solution. Therefore, a pretreatment system was designed to filter, neutralize, and remove oils and heavy metals from the spent cleaning solution. Current microfiltration, ferrous sulphate and oil separation technologies were incorporated. The treated product may be discharged to the sanitary sewer as non-hazardous waste. The treatment residue, which accounts for less than 10% of the original waste volume is disposed of as hazardous waste through outside sources. This system provides a payback of less than one year by offsetting annual disposal costs of over \$200,000.

Distillation of Freon and Mineral Spirits

An excess of 50,000 gallons of used Freon solvents and mineral spirits combined were previously disposed of as hazardous waste each year at a cost in excess of \$150,000. A series of solvent reclamation stills has been implemented which can recover the used solvents at a high purity level, virtually eliminating the need for disposal. Reuse of the recovered solvents has substantially reduced the need to purchase new solvents, yielding an additional annual cost savings of over **\$75,000**. At a cost of approximately \$50,000, this system has provided a payback of less than one year.

Metal Pipe Cleaning

Aluminum, copper, copper-nickel, ferrous steel and stainless steel pipe must be chemically cleaned through a multiple step process to remove oxidation and surface contaminants prior to welding and painting. During the process the pipe is rinsed in a water bath between each chemical application. The used rinse water constitutes hazardous waste due to heavy metal and chemical content and must be disposed of through an outside contractor. An alternate rinse process is being designed incorporating countercurrent rinse baths. Excess rinsewater is evaporated, condensed and returned to the final rinse bath. The remaining solids are disposed of as waste. This closed loop system reduces the waste stream from this cleaning process by over 95%.

Hard Chrome Plating Retrofit

An innovative system designed by NEESA was implemented to eliminate the need to dispose or treat rinse water generated by traditional plating techniques. The reversible rack, twin bus bar, zero discharge system uses a mist to rinse parts, returns the rinse water as make up water for the plating bath, and cleans the bath with a special porous filter. This process eliminates the need to dispose or treat used rinse water or dump the plating bath.

Paint Booth Water Treatment

Water utilized as a "curtain" in paint spray booths was traditionally disposed of as waste upon saturation with paint sludge. A system has been implemented to recycle this water. A non-hazardous chemical flocculant is metered into the booth water. The chemical causes the paint sludge in the water to flocculate. The sludge is then easily removed and the water is recirculated in the booth. A 90% reduction of this waste stream has been achieved with this process.

Can and Drum Shredder

This device converts used cans and drums to marketable scrap metal. These containers were otherwise manifested as hazardous waste due to their previous contents. Implementation has resulted in the elimination of 83 tons of waste per year.

Plastic Media Stripping

Numerous paint stripping **Operations** exist throughout the shipyard. A large portion of them incorporate hazardous solvents such as methylene chloride as the stripping agent. With technical guidance from NEESA, PNSY will be implementing alternative stripping using plastic grit that is harder than paint but softer than metal parts. This mechanical blasting process will eliminate handling and disposal of hazardous liquid strippers.

CONCLUSION

Full scale implementation of all the projects described will enable PNSY to easily achieve the goals set forth at the onset of the program. In fact, the CNO goal of 50% reduction by 1992 will be met exclusively through minimization projects in the motor shop, pipe shop, and by solvent distillation alone. The projection shown in figure (2) is based on this information.

MEETING THE CNO GOAL UTILIZING HWM PROJECTS

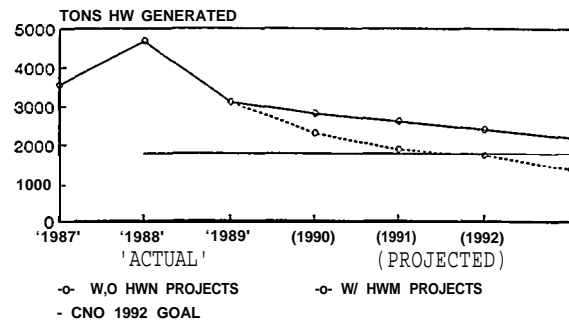


figure 2.

As a result of these efforts, PNSY will significantly reduce generations and amount of hazardous waste going to land disposal, drastically reduce costs associated with disposal, and remain legally responsive to federal, state and local environmental regulatory agencies.

References

- G.H. Bennett, C.T. Philipp, "Industrial Wastewater Pretreatment Seminar", University of Toledo Division of Continuing Education, March, 1990.
- Paul N. Cheremisinoff, "Water and Wastewater Treatment Fundamentals and Innovations", pollution Engineering, March, 1989.

Additional copies of this report can be obtained from the
National Shipbuilding Research and Documentation Center:

<http://www.nsnet.com/docctr/>

Documentation Center
The University of Michigan
Transportation Research Institute
Marine Systems Division
2901 Baxter Road
Ann Arbor, MI 48109-2150

Phone: 734-763-2465
Fax: 734-763-4862
E-mail: Doc.Center@umich.edu